Hockley Mill Sluice Rebuild

Ivor New and Mick Edgeworth

All photos by Mick Edgeworth

The finished sluice

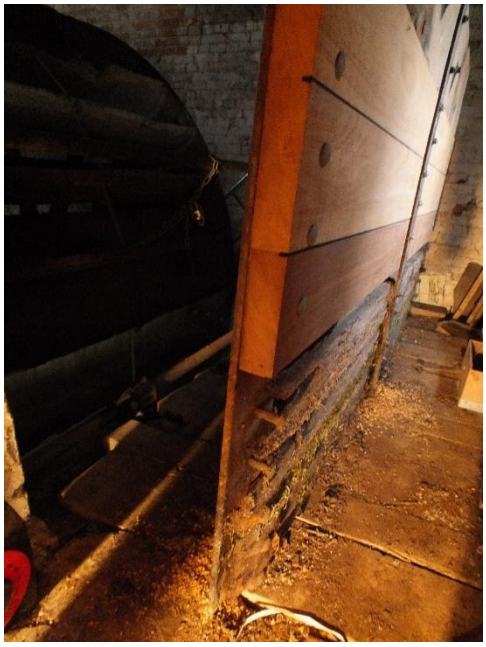
The waterwheel sluice at Hockley Mill has recently been rebuilt. The sluice had been progressively failing over several years until eventually it became incapable of stopping the waterwheel revolving. Before this project was completed the only sure way of stopping the wheel was to perform a risky procedure of jamming a length of timber between the rim of the wheel and the side of the wheel pit.

Some months ago one of HMG's members Ivor New was persuaded to undertake a design study and repair the sluice. Essentially the brief was to provide a sluice that had a long working life with low maintenance requirements, all at minimal cost. There was no restriction on materials used as long as the existing control arrangement was retained and there were no constraints on returning it to the original design and materials. A detailed examination of the sluice showed that it was in far worse repair than expected and would require a complete rebuild (*as shown on the right*).

All the boards of the sluice, apart from the top board, which was well above flood level, needed replacement. The good news was that the sluice operating gear and iron work was in relatively good condition and reusable.

The first phase of the project was a design study to determine the materials and repair strategy to be used. The decision was made to use iroko for the sluice boarding with galvanised fittings and fixings, the reasoning being given in an appendix below. The required materials were purchased and the project implementation started on site where the work progressed smoothly, if a little slowly. The iroko boards were supplied cut accurately to length, thickness and combined overall width. To improve the long term performance of the sluice it was decided to incorporate a seal between the boards. To achieve this rebates were cut down the mating surfaces of the boards to house strips of self-expanding weatherproof foam.

The rebuild work started by installing lifting points on the sluice and in the beam above it. The sluice was then raised as far as possible using its own operating gear and then lifted clear of its guide slots using a chain hoist. It was set down on the floor in front of the wheel where the rebuild was performed.

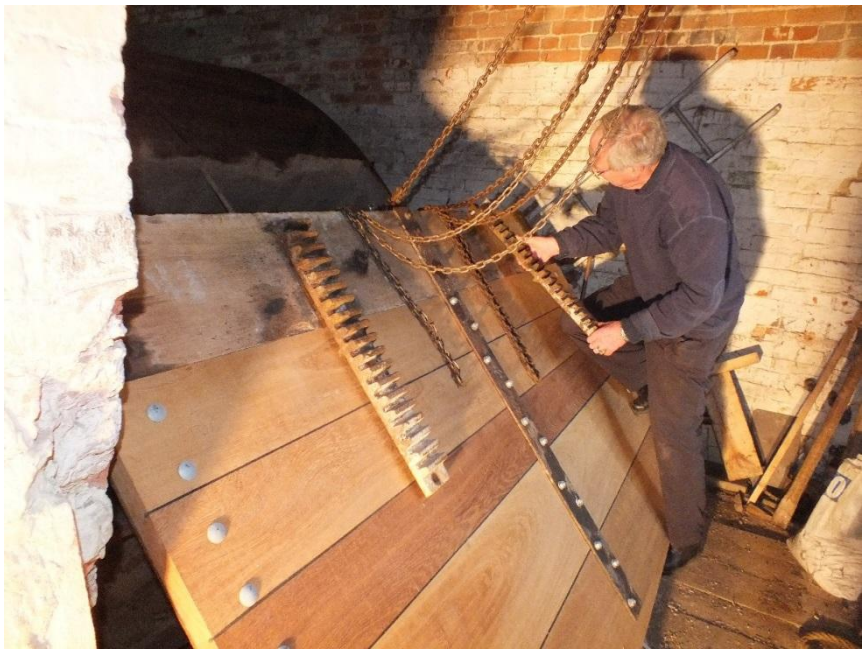


The initial task was to remove two cast iron racks, part of the operating equipment, from the face of the sluice. Prior to removing them their location was marked on the top board of the sluice. Careful measurements were taken throughout the work. The remains of a few boards immediately below the top board were then stripped off, leaving the lower boards in place to maintain the alignment of the iron strapping.

Work continued by cleaning the heavy rust scale from the iron straps that locate and reinforce the boards. The new boards were installed working downwards from the top board, each having its sealing strip inserted and being carefully aligned and clamped in place before being drilled and bolted to the existing iron straps. This process was repeated, removing old boards as necessary, until all the new boards were in place. New metal rubbing strips were then slotted into place at either end of the sluice to protect the timber where it was especially prone to wear.

The final task of replacing the racks for the operating mechanism was much simplified by the retention of the top board which provided the basic location references.

With the sluice now rebuilt (and looking very smart) it was time to haul it up and slide it back into its guide slots in the wheel pit. All went well until the sluice had travelled some way down the slots, where it jammed. After spending some time trying to persuade the sluice that it really did want to slide into place, it was decided that the best policy would be to find out what was actually causing it to jam. The sluice was lifted out and after looking very carefully at the guide slots it was realised that they narrowed slightly as they descended, which required the ends of the sluice to be slightly wedge shaped. To ensure the required taper was correct, patterns of the slots were made which were then converted into router jigs. The new rubbing strips were temporarily removed so the jigs could be attached to the sluice and a router used to cut the required profiles.



Ivor replacing a rack. Notice the original top board and the central iron strapping.
The new sluice is about to be hauled into position for the first time.

The sluice was again hauled into position and let down into its guide slots. This time it slid down further but was stopped by the rack and pinion which would not engage as the pinion shaft was too close to the sluice. The good news is that when the pinion shaft was unbolted from its mountings the sluice slid nicely into place. It seems that the last time work was done on the sluice the timber was already badly worn and the shaft was setup without taking this into account. Unfortunately the pinion bearing mounting plates had been replaced and relocated without taking any wear into account, so modifications had to be made before the drive shaft could be realigned, all of which took time to get right.

Finally, the sluice was ready for its first working trial. It was impressive how smoothly and well the sluice operated, so well that it descended at a rate that pushed the operator's hands away from the control wheel and shut with a considerable bang. Fortunately no damage was done to the mill or the operator. Now we come to a slight difference of opinion – half the team was just delighted at the first time performance of the sluice, while the other half promptly

demanded either a brake or a counterweight system be fitted, with a secondary requirement that any such system should not detract from the photogenic quality of the mill. Ivor was up to the task and a counterweight system was designed and built to meet the additional requirements.

The last task was to service the sluice operating mechanism which was taken apart cleaned, adjusted and re-greased. To simplify and thus improve the quality of maintenance, grease nipples were fitted to greasing points, several of which had not been used for a very long time.

The project is now complete and is considered a significant achievement with the new sluice operating correctly and safely, together with an expectation that it will provide decades of good service.

Hockley Mill will be open on Sunday 11 September from 11am to 4pm.

Hockley Mill in 2015
Compare this with the older picture on the front cover.
– *Keith Andrews*

Notes on the selection of boarding for Hockley sluice

To fulfil the design brief, it was decided to look at three materials to determine the best option for the sluice boarding. These were Seasoned Oak, Iroko, and Recycled Plastic. The results of the comparison for this sluice were:

Seasoned Oak. This was the reference material. Its properties are well known and it is generally available in the area, certainly in its green form. Seasoned oak of the dimensions required is not so readily available and generally requires re-machining to dimension to correct shrinkage and movement during seasoning. Prepared seasoned oak is not cheap.

Iroko. This is a sustainable tropical hardwood that has very similar mechanical properties to oak but is significantly more durable and with an expansion coefficient, when wetted, half that of oak. It also lacks the high tannic acid

content of oak so galvanised fixings rather than stainless ones perform well. Iroko is used extensively by the Canals and Waterways Trust on their projects throughout England.

The cost of the machined timber required for the sluice was less than for seasoned oak, although this was subject to an agreement with the timber merchant whereby the boards would be of the correct length and thickness but could vary a little in width as long as the number of boards and the sum of their overall width was correct. Considering the above the decision was made to use iroko for this project.

Recycled Plastic. As part of this exercise it was decided to investigate the use of recycled plastic boards as even though being a non-traditional material and thus unacceptable to many, they are virtually indestructible in the sense that they are proof against insect and fungal infestation. Their effective use as boarding in waterfront and simple water control applications is now well established and in many conservation situations could simply be replaced with boards of the original material if required.

Assuming most readers will have no interest in Bending Moments and Young's Modulus and such like, let it suffice to say that plastic boards are about ten times more bendy than oak. The effect of this on a Hockley-sized sluice would be that the pressure of water in flood conditions, without other support, could potentially bend the sluice's bottom board a distance measured in inches. The use of a plastic board reinforced with internal galvanized steel bars was also looked at but while this considerably reduced the amount of bending there would still be a lot of movement. Finally, the price of these boards is at least as expensive as hardwood (the manufacturer's reasoning being that they are virtually indestructible and hence a premium price is justified). The use of these boards was rejected for this project.

Even having rejected these boards for our project there are other uses where they could provide significant benefits. While not a traditional material, plastic does have properties that would be useful in some circumstances, certainly when used for what are essentially service items. As an example it would be interesting to investigate how they would perform as replacements for wooden float boards on a waterwheel, particularly one that is idle much of the time and so prone to decay and balance issues.